



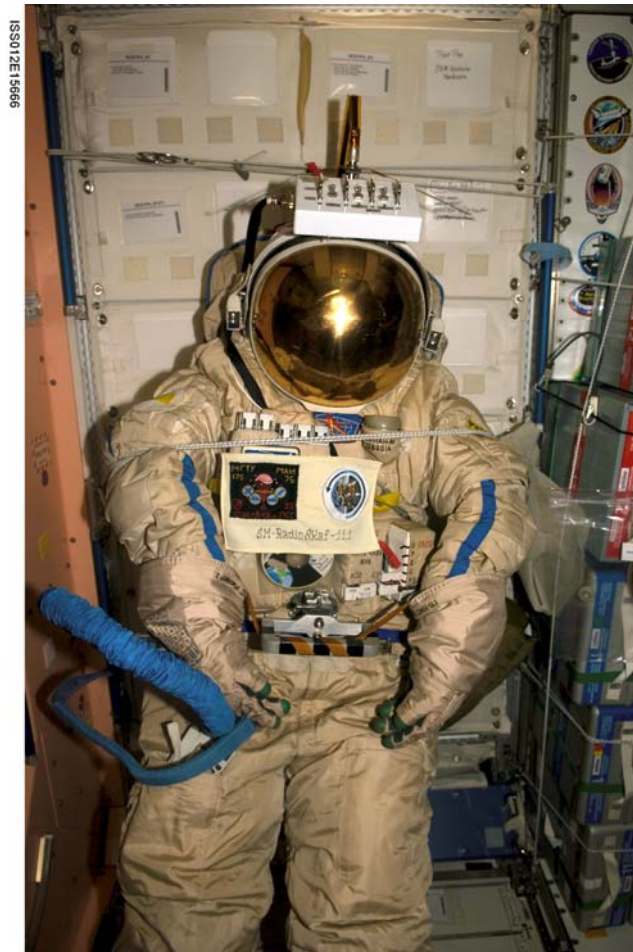
## SuitSat-2



Lou McFadin  
W5DID  
May 19 2007



## Suitsat 1 ready for Deployment



Lou McFadin W5DID



## SuitSat-1 Mission and Capabilities



### Primary mission

Voice message Commemorating the 175th Anniversary of Bauman state University Moscow.  
This included audio greetings from

Energia, Bauman State University, ARISS Europe, ARISS Canada, ARISS U.S.A.  
ARISS Japan

A CD ROM with photos contributed from schools around the world.

### Secondary mission

SSTV images of Earth and Station

Amateur operations

Packet ops

Beacon

Earth sensor test data

Gather real space operating data and  
experience on several candidate sensors for Eagle.



## SuitSat-2 Mission and Capabilities



Primary mission

Voice messages Commemorating (TBD)

This includes audio greetings from

Energia, ARISS Europe, ARISS Canada, ARISS U.S.A. ARISS Japan

A CD ROM with photos contributed from schools around the world.

Secondary Mission

Testbed for systems planned for future Amateur radio satellites

Amateur operations

CW ID

Packet ops

SSB Transponder

FM Cross band repeater

SSTV images of Earth and Station

Experiments (TBD-TSFR)



# SuitSat-2 Top Level



- SuitSat-2 will transmit voice messages commemorating Tsiolkovsky's birthday as a primary objective.
- A second objective will be to use the suit as a test bed for Amateur Radio satellite operations including packet operations, SSB transponder, FM cross band repeater, SSTV, and the opportunity to fly additional experiments designed by university students. A solar power system will also be used.



# The Proposed Plan



- Build upon Suitsat-1 design
- Re-use safety interlock circuit with update for Solar panels
- Transmitter and Receiver module
- IHU Module
- Control Panel same as Suitsat-1
- New Power module for solar panels
- Solar Panels
- Up to Four Experiments
- Four Temperature Sensors
- Up to Four cameras for SSTV



# Future Concept Testbed



- Use as a test bed for new concepts for future Amateur radio Satellites.
  - ♦ Eagle power system
    - Max power point converters for solar panel
    - Distributed Converters
    - Distributed Storage system
  - ♦ Software Defined Radio (SDR) Prototype
  - ♦ Additional experiments



- SSTV
  - ◆ Four video ports
  - ◆ No power until switched on just before data take.
  - ◆ Four U.S. Supplied
  - ◆ No blank video
    - Processor examines video and skips if no image present





# Experiments



- Experiment ports
  - ♦ Four ports
    - One reserved for MicroChip (Supplier of electronics) non commercial.
    - Three for other experiments
    - Data packets to be 2k Bytes transfered on request from the IHU.



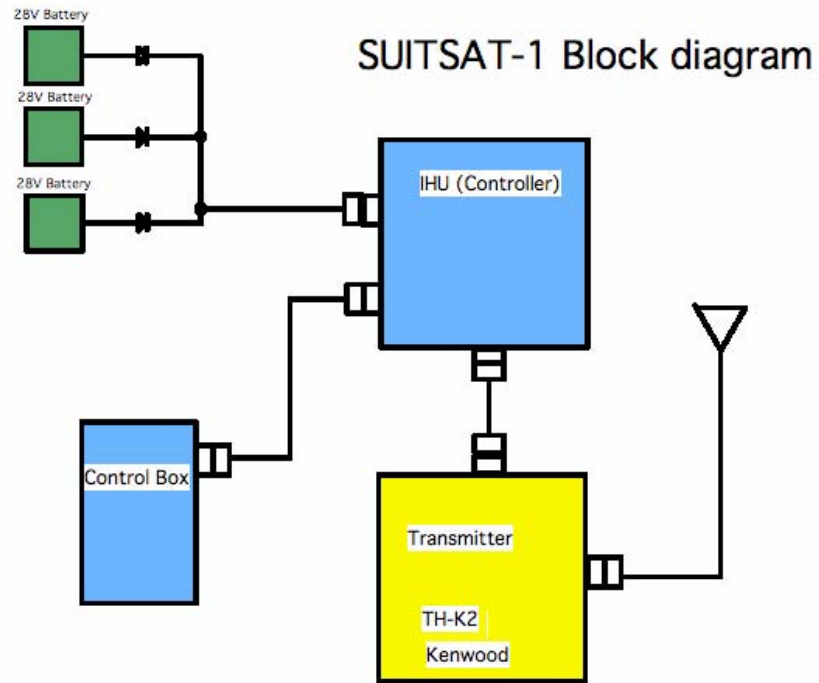
# Radio Module



- Radio
  - ♦ SDR Eagle prototype
    - Multimode
    - SSB Crossband (U/V) Transponder repeater with Telemetry beacon
    - FM-FM Crossband (U/V) packet
    - Multiple signals simultaneously

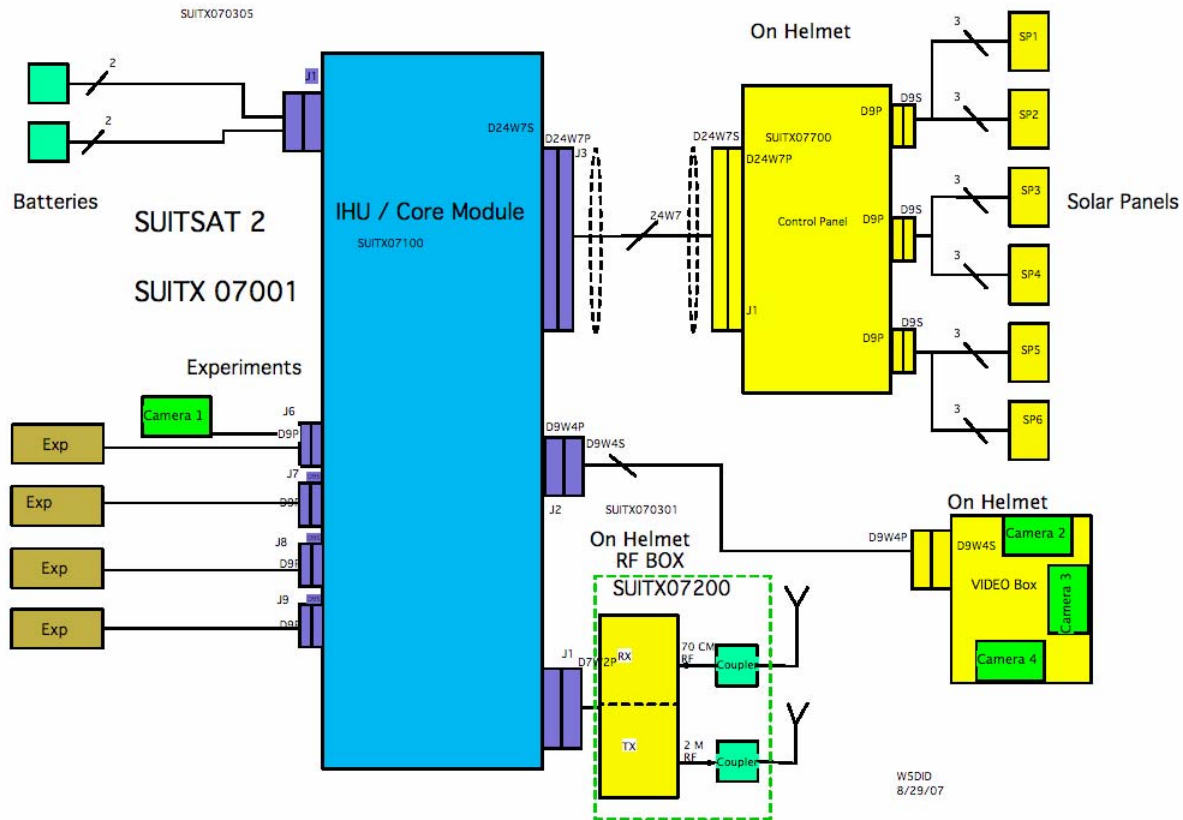


# Suitsat-1 Block Diagram





# Suitsat 2 Interconnection diagram

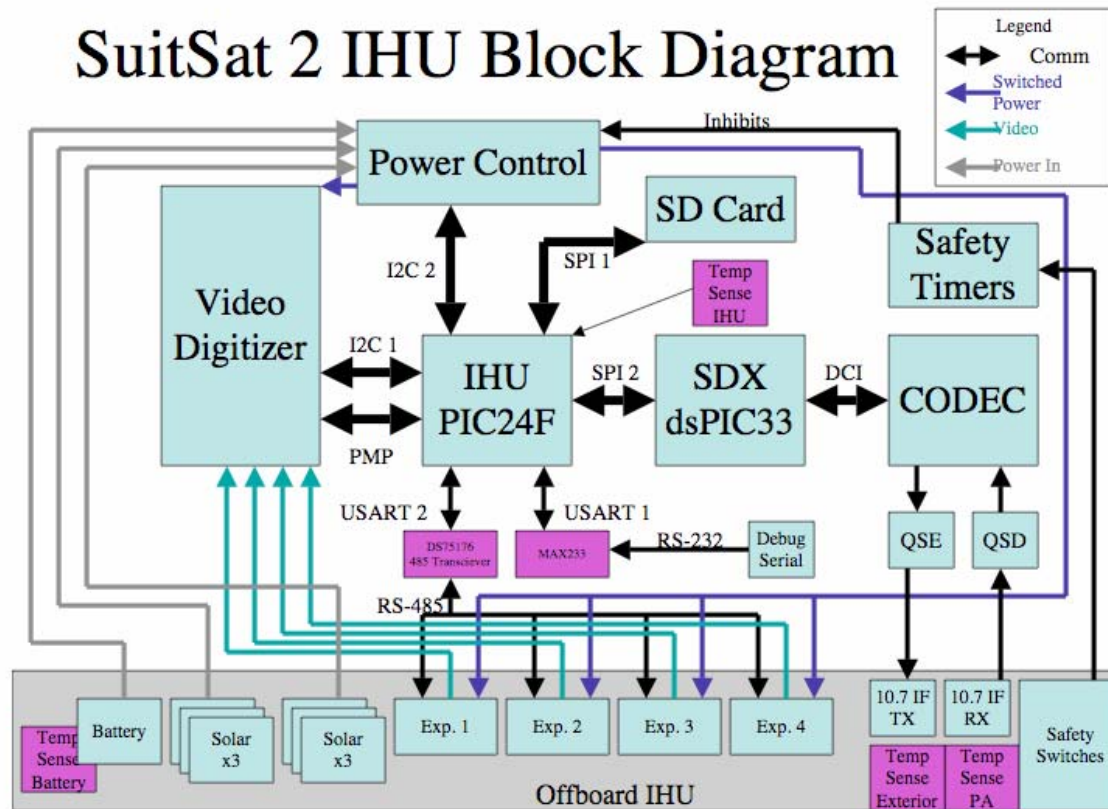




# Suitsat 2 System Diagram



## SuitSat 2 IHU Block Diagram





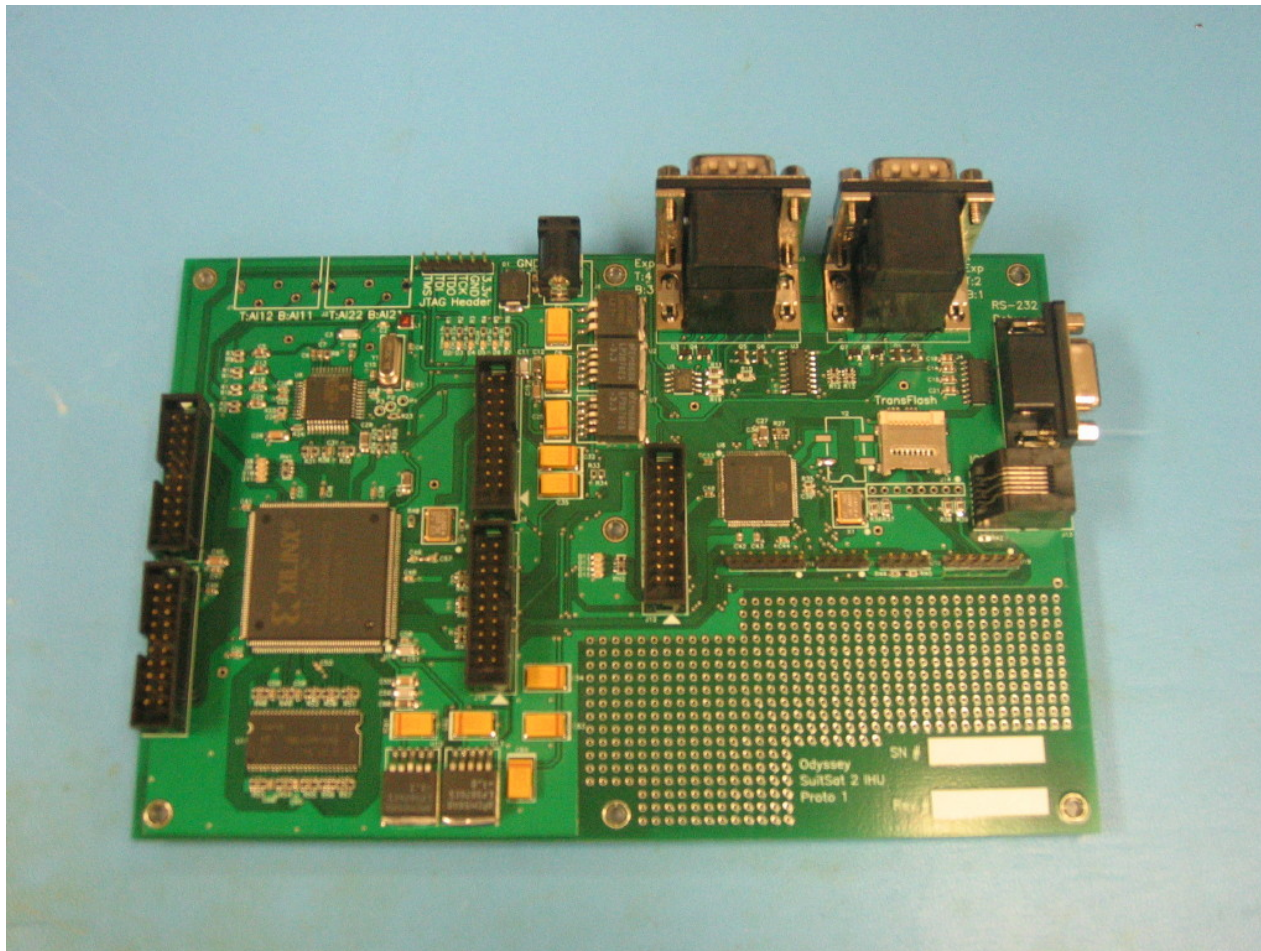
# Suitsat 2 Power controller



QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.



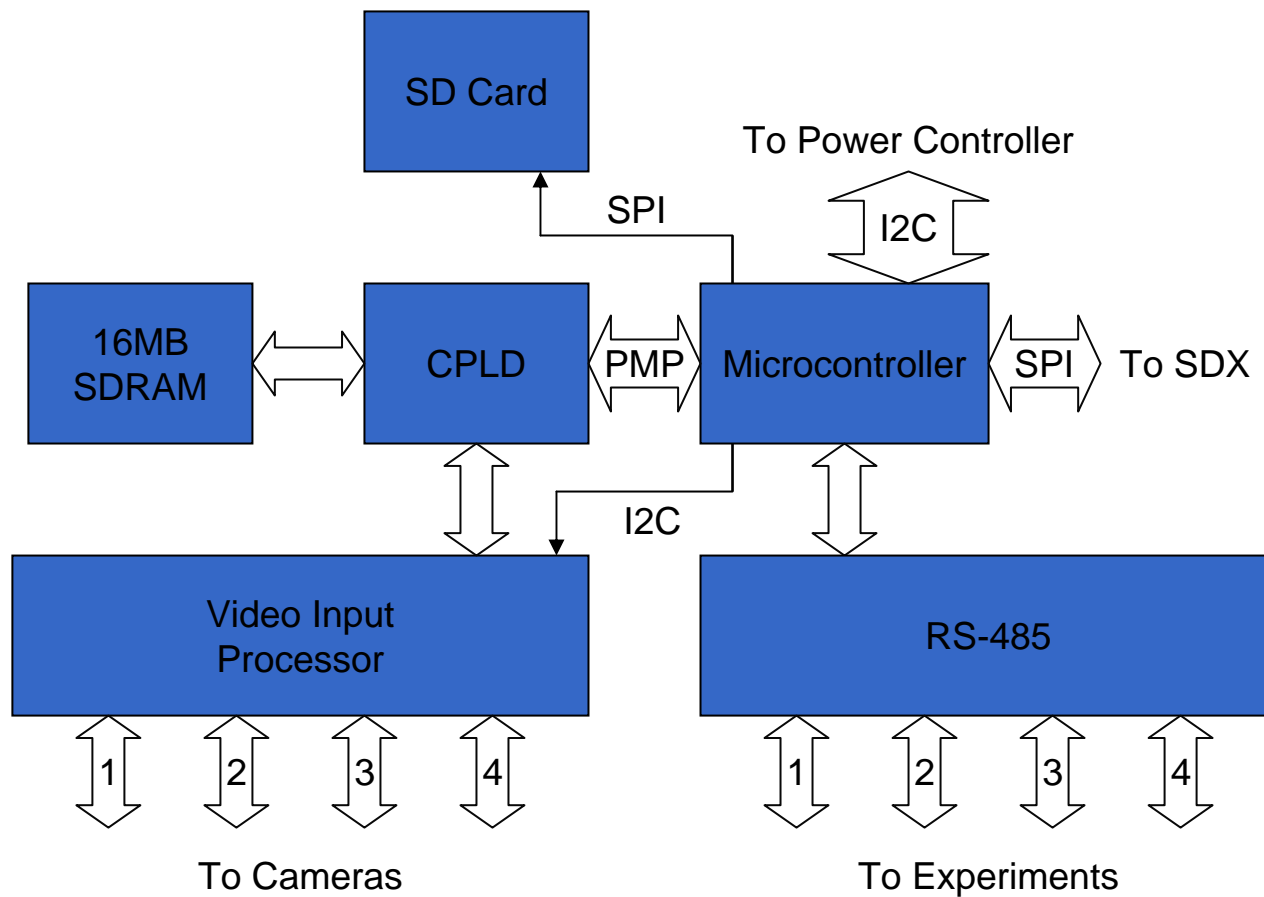
# Suitsat 2 IHU and Core Module



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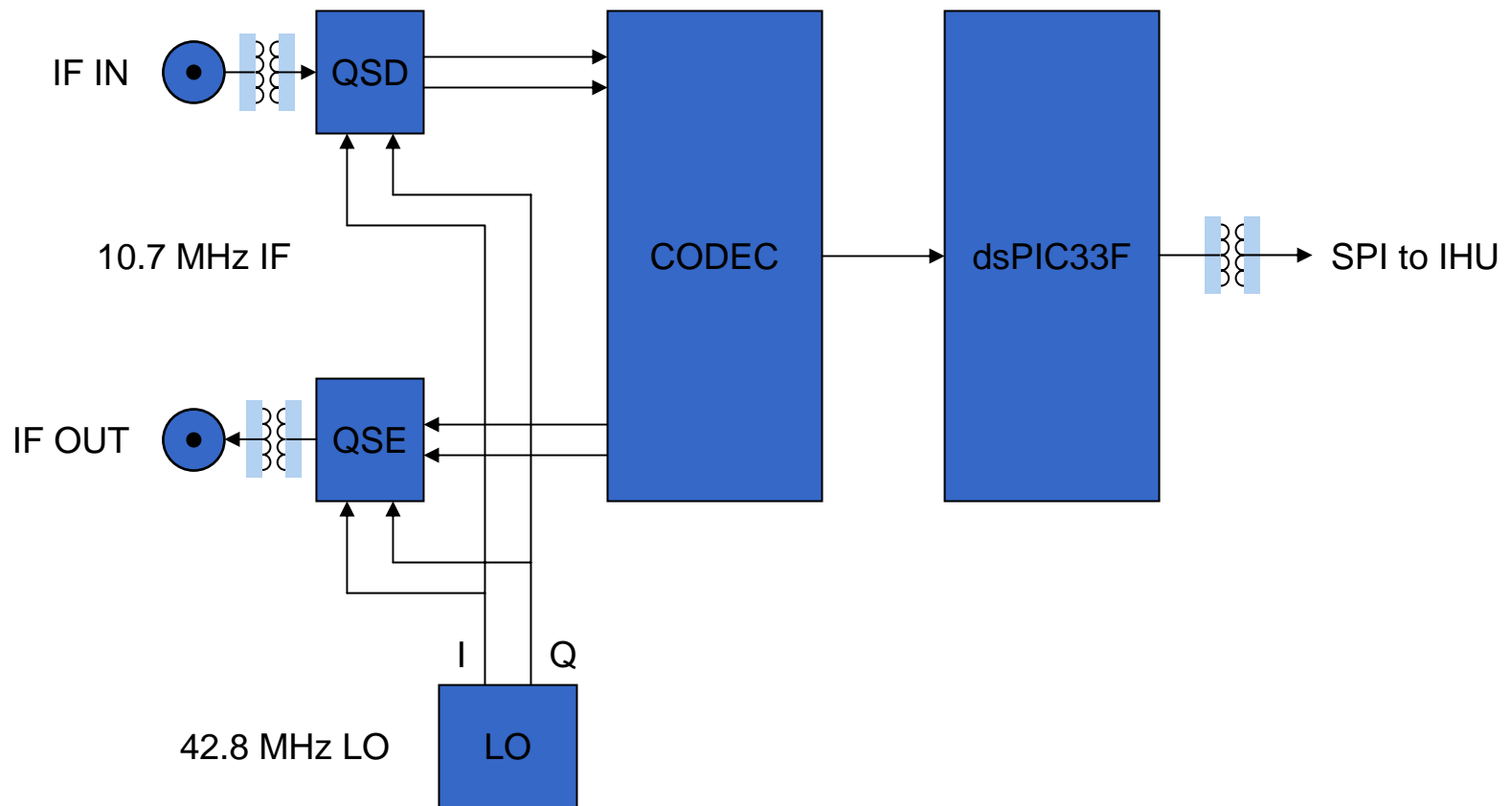
# SuitSat-2 Internal Housekeeping Unit (IHU) Block Diagram





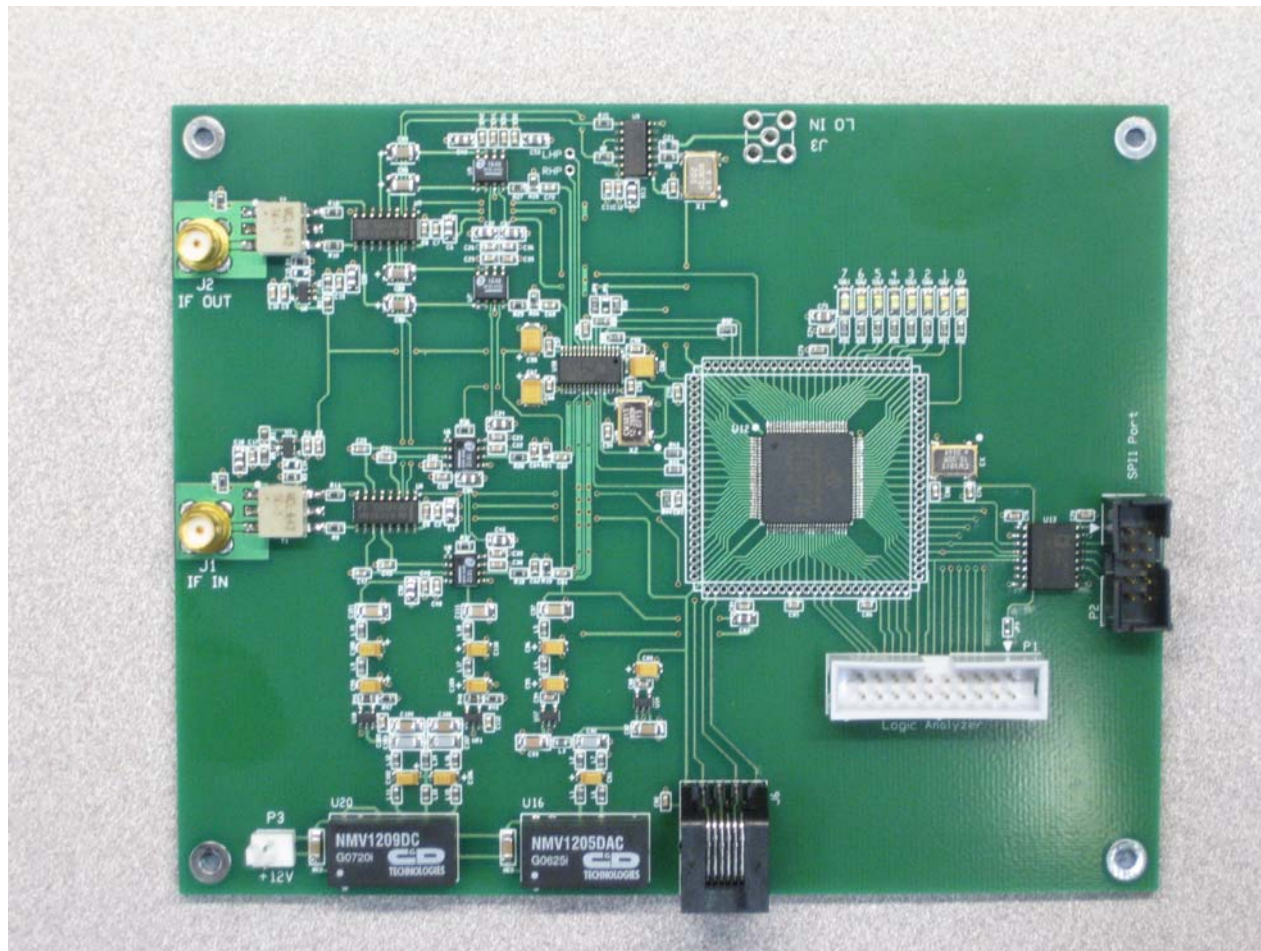


## SuitSat-2 Software Defined Transponder (SDX) Block Diagram





# Suitsat 2 SDX



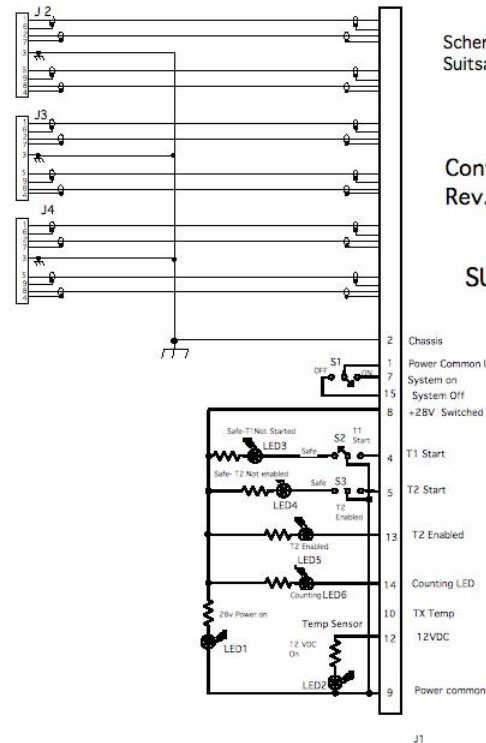
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# Suitsat 2 Control Panel



Solar Panel cables



Schematic Diagram  
Suitsat 2 Control box

Control Panel  
Rev. A

SUITX 07701

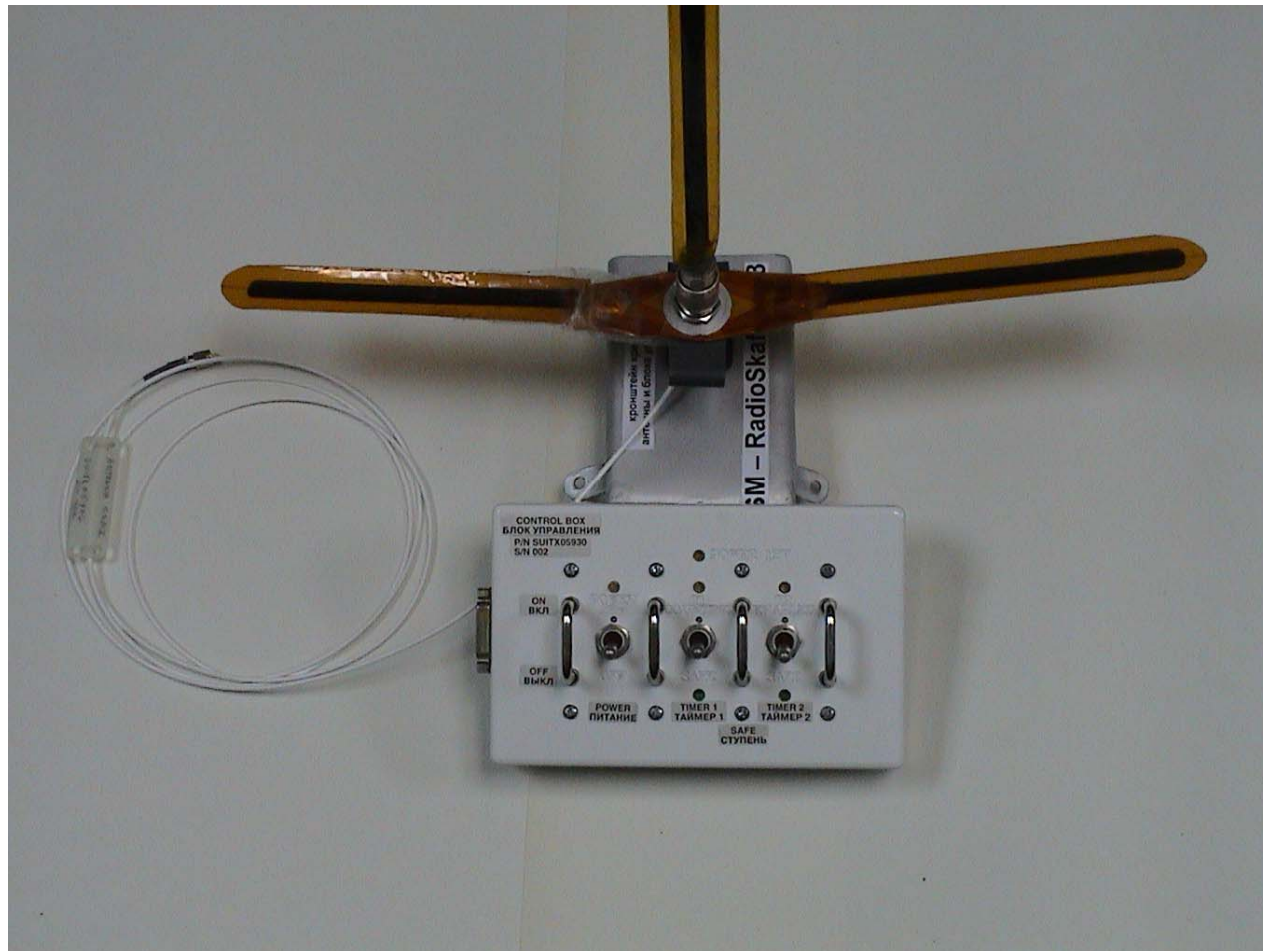
Next ASSY SUITX07700

W5DID  
8/28/07

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# Suitsat 1 Antenna

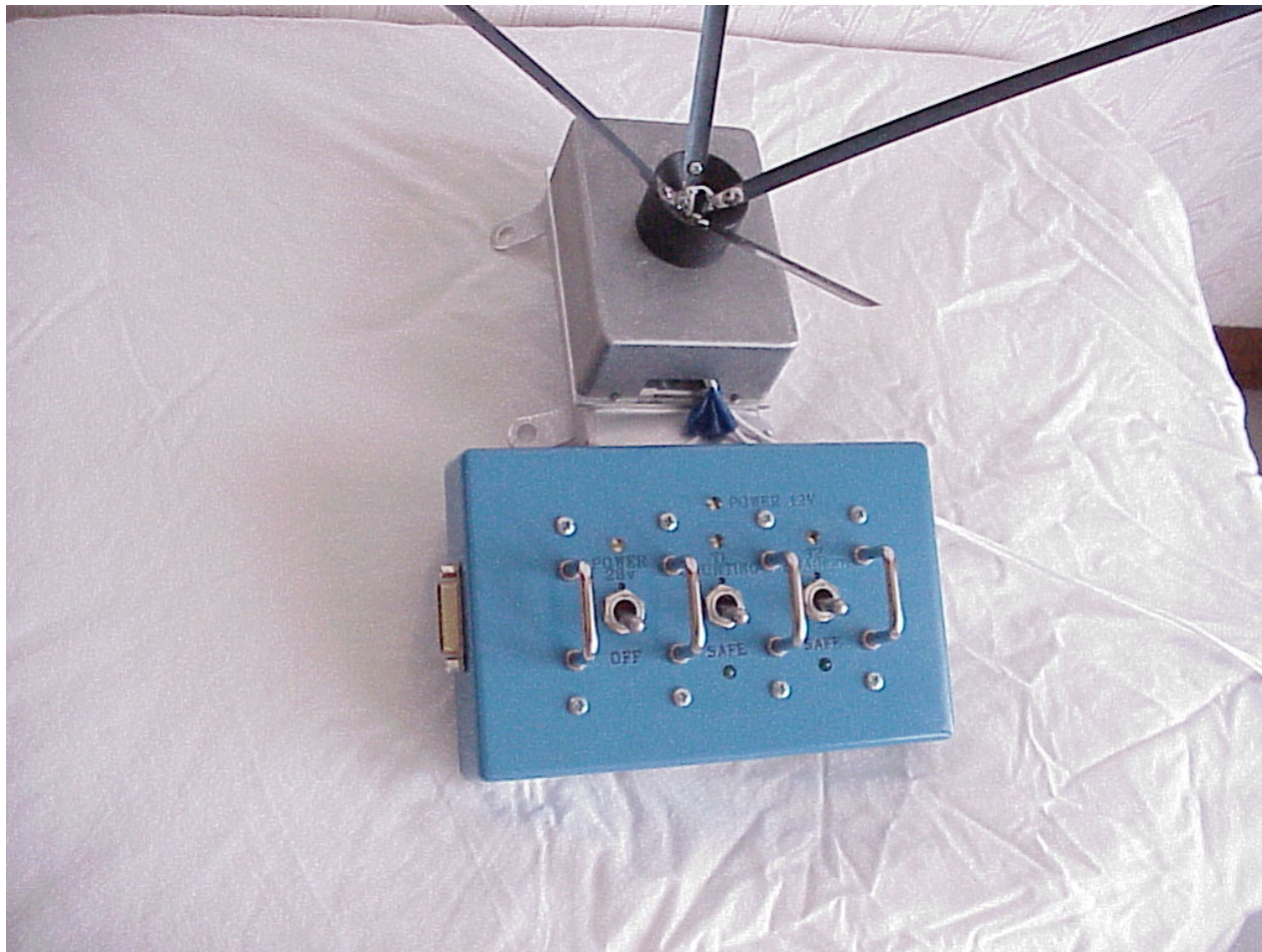


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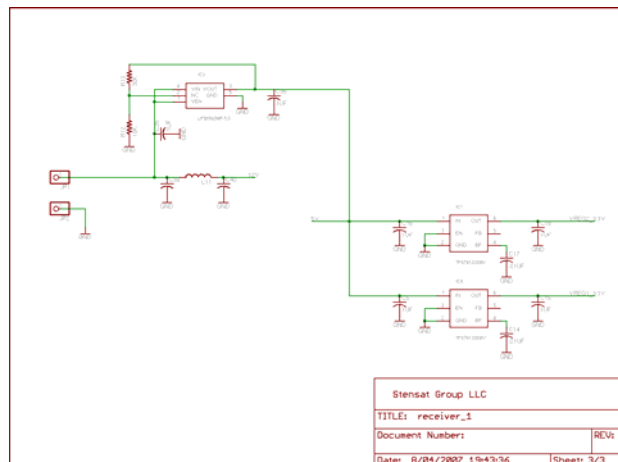
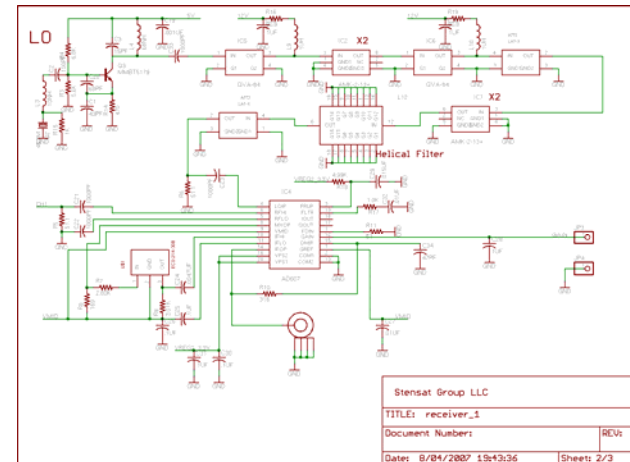
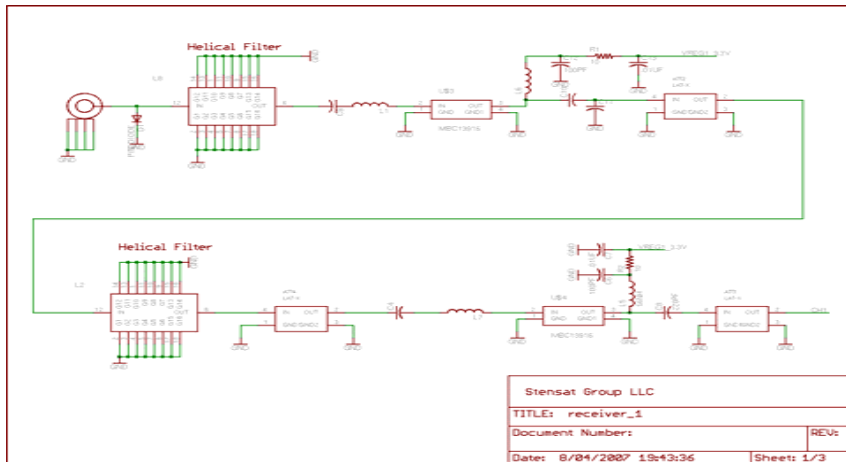
# Suitsat 2 Antenna



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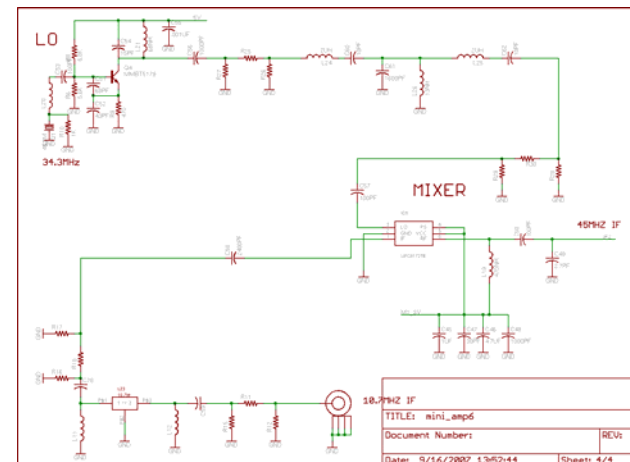
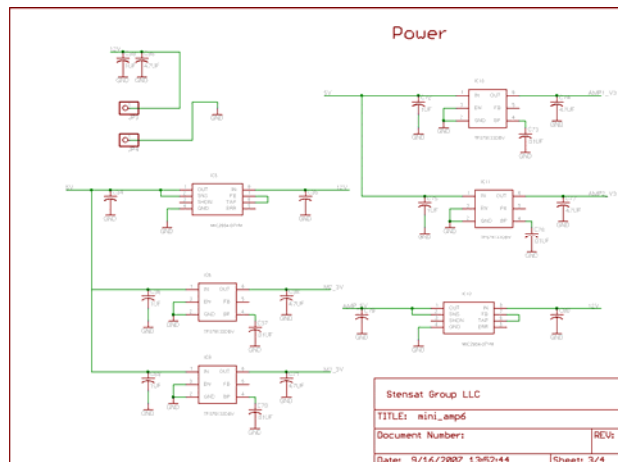
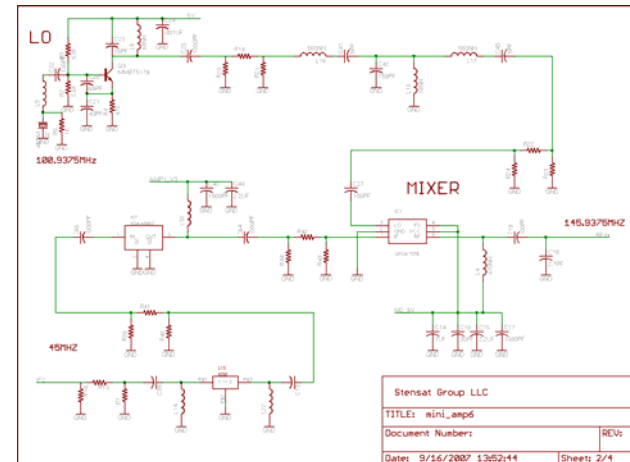
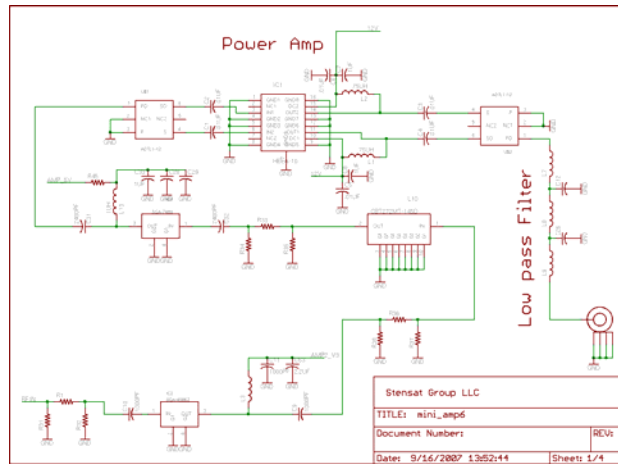
# Suitsat 2 Receiver



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# Suitsat 2 Transmitter





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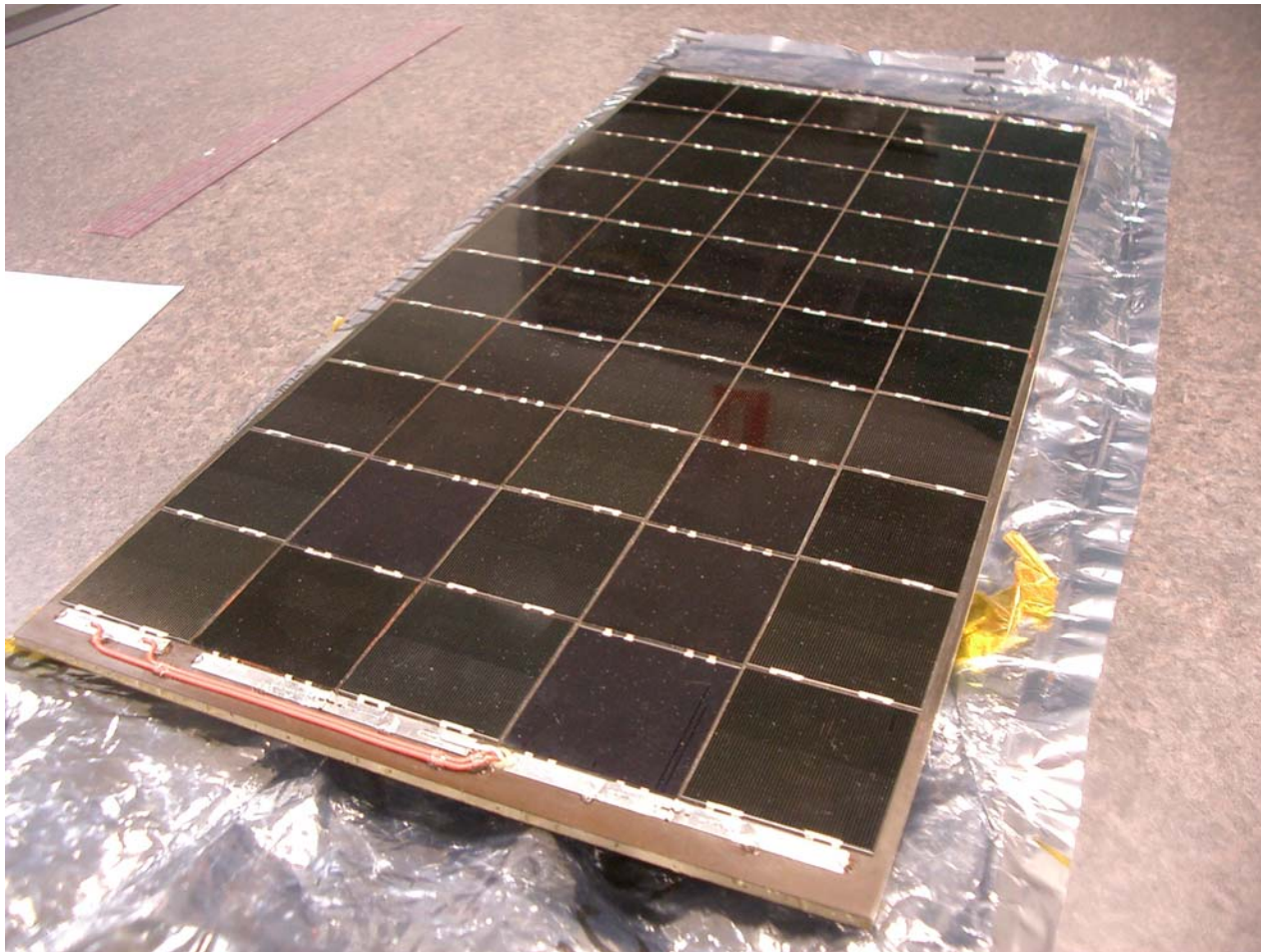
# Solar Power System Possibilities



- NASA supplied.
- Surplus from previous NASA SMEX (SMall EXplorer) satellite program.
- Power converter based on planned Eagle design.
- Designed to charge the surplus ISS Russian Space Suit batteries.



# SMEX Solar Panel



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# Suitsat 2 Solar Panel Assembly

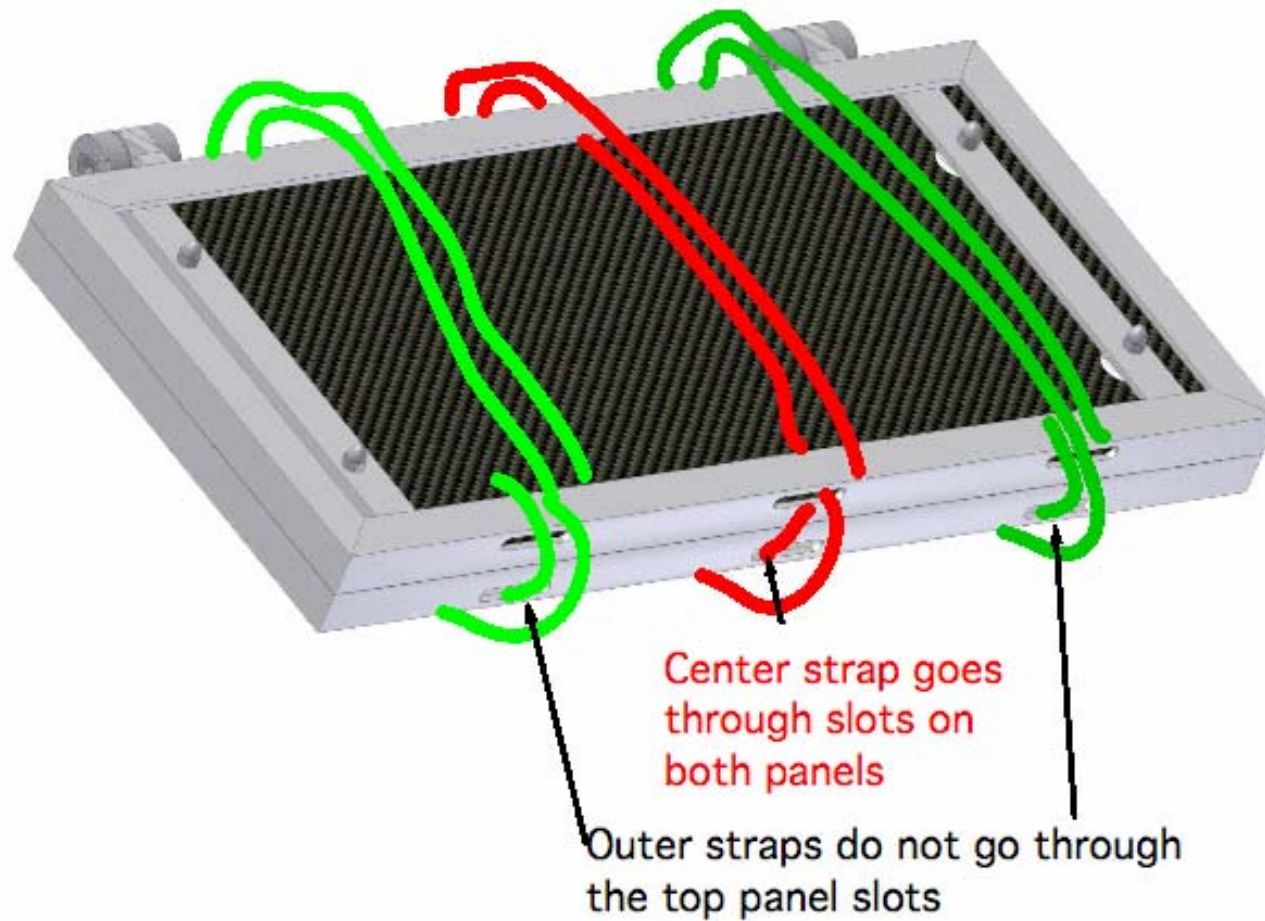


- SMEX Panel is mounted in hinged frame that is closed until deployed outside cabin.
- Panel secured closed by three two sided velcro straps until attached to suit inside cabin.
- Two outer straps wrap through slots in side of frame behind the bottom panel.
- Center strap is threaded through slots in both panels and is used to secure the panels in the open position

QuickTime™ and a  
TIFF (LZW) decompressor  
are needed to see this picture.

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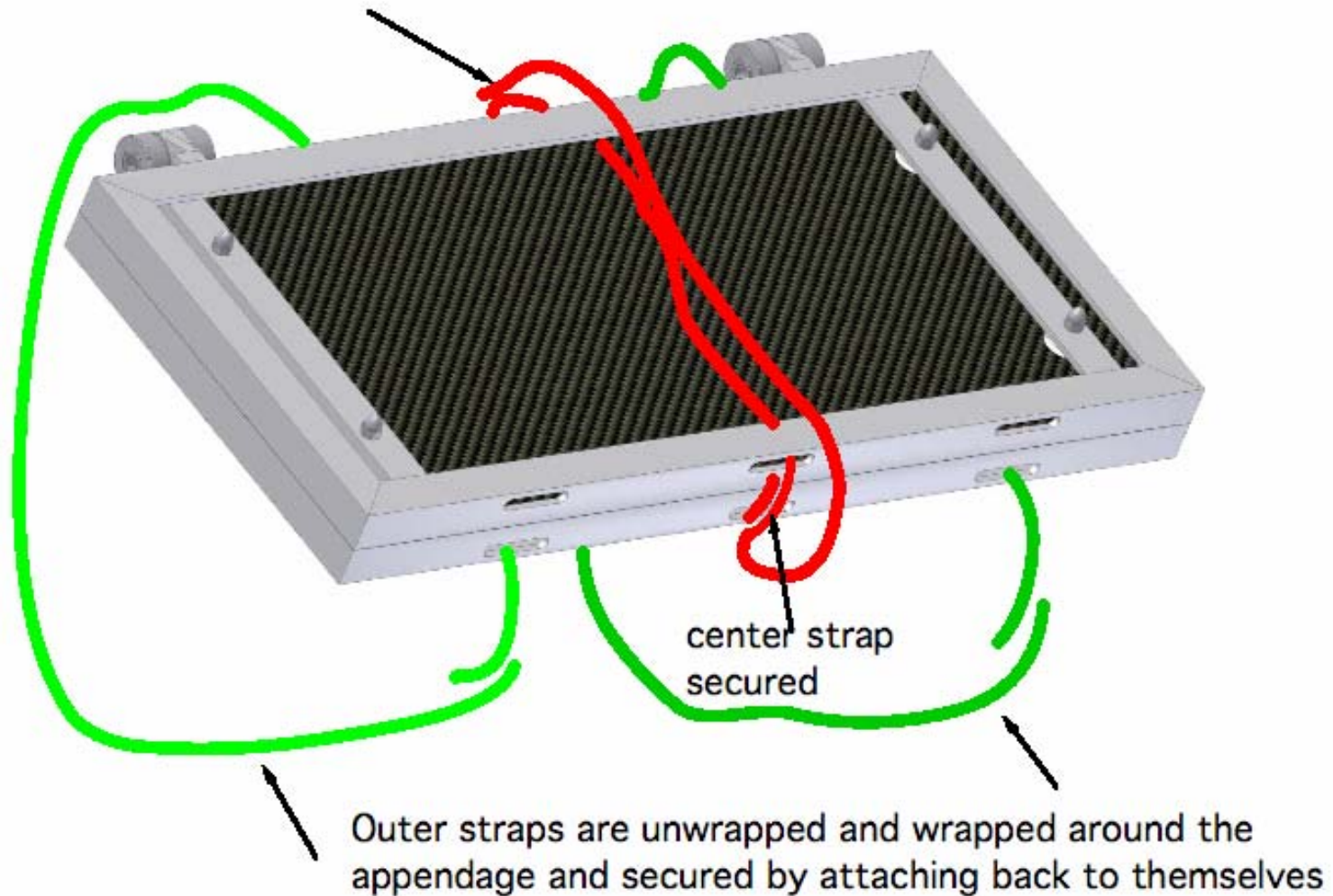
Solar panels closed secured for handling and shipping



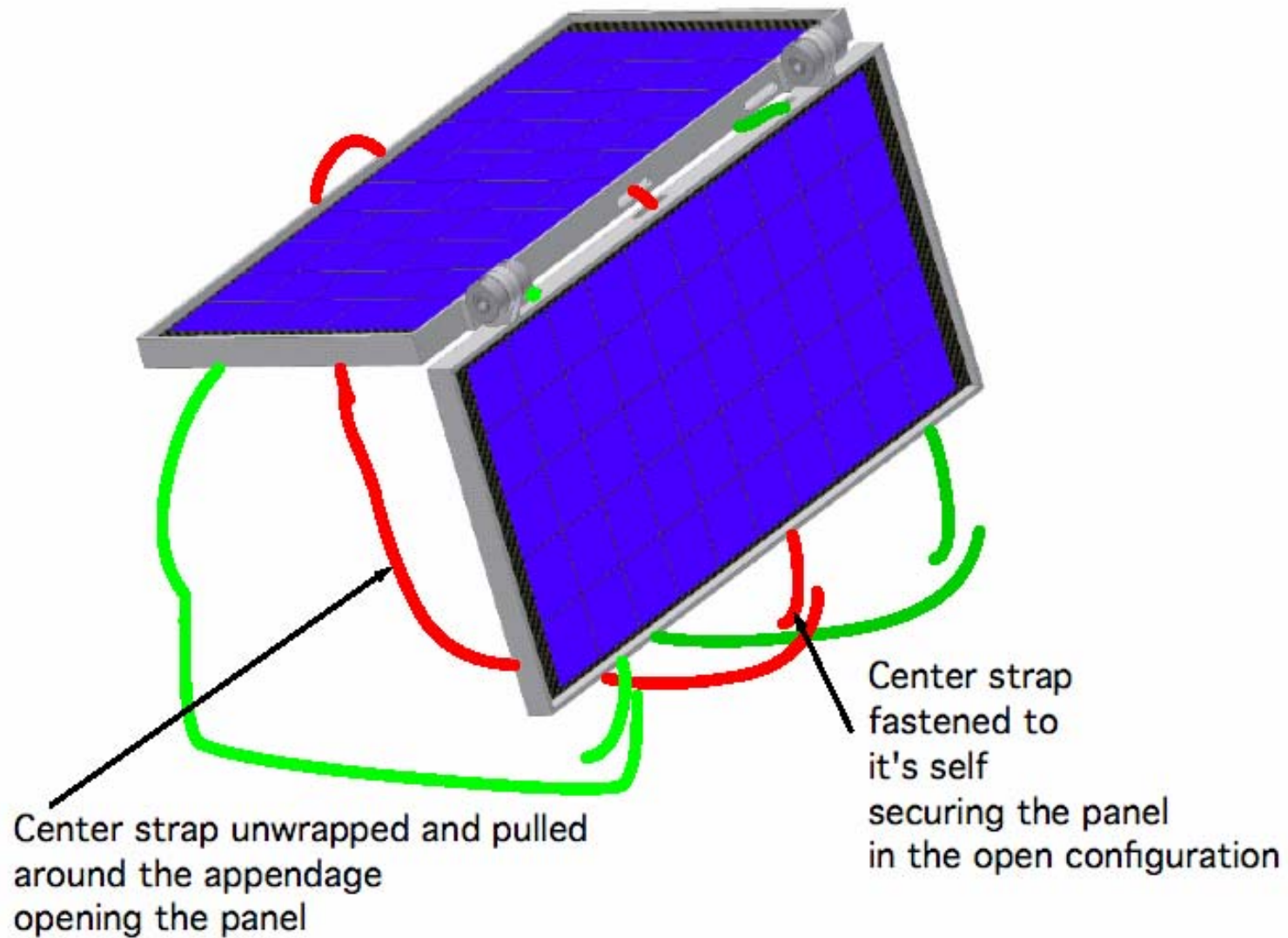


Solar Panel mounted on suit appendage but not deployed

Excess center strap length secured on its self on the top of the panel



## Suitsat 2 Solar panel deployed around an appendage





# Scientific Experiments



- The ARISS team will work together to determine how to select the schools that will fly experiments on SuitSat-2. Sergey indicated that there are at least 5 Russian universities interested in running experiments on SuitSat-2. GPS might be used in one experiment. Limitations include 5 watts, data rate, and short pass time of the suit (expect operators all over the world to help collect data from the experiments).
- Four CCD cameras will take pictures and whichever one has the image will be encoded and transmitted to the ground. The formats available will be Martin, Scottie- 1 and Robot-36. Cameras have been identified, but have not yet been purchased and will need to be certified.



200 Series

**BOARD CAMERA**

- ♦ Full digital process of BLC
- ♦ Auto Tracing White Balance
- ♦ 2H mode of H.V. aperture correction
- ♦ Digital process of color matrix
- ♦ Electronic Shutter up to 1/100,000
- ♦ CS mount lens available
- ♦ 24VAC Optional

HTC-260

HTC-2N1

HTC-250

BUILDING A NEW RESOLVE ERA

**Digital**  
Processing

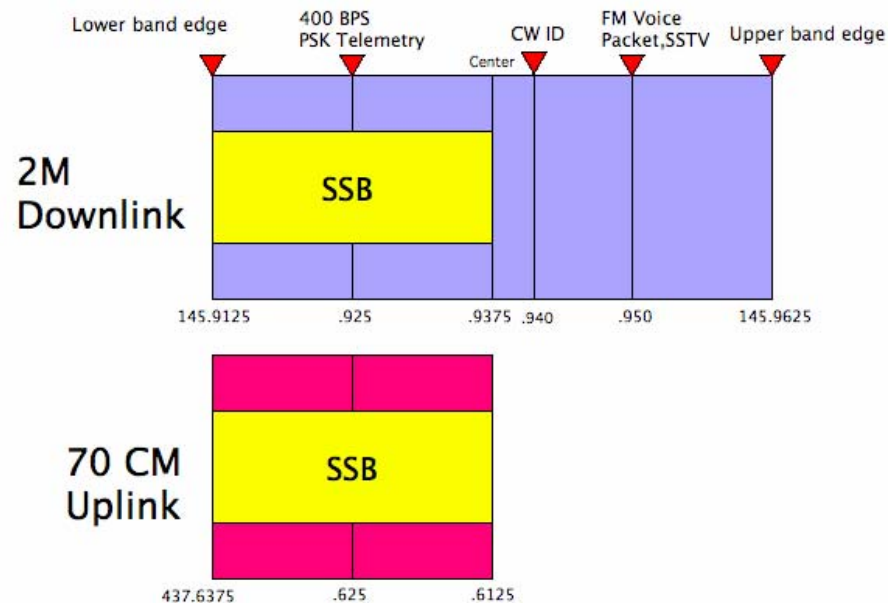




# Proposed Suitsat 2 Band plan



## Proposed Suitsat 2 Band Plan (REV B)



Downlink Frequency = 583.55 - Uplink frequency

W5DID  
7/11/2007



# Educational Outreach



- **Educational Outreach**

- Educational outreach activities will include:
  - CW callsigns,
  - SuitSat website,
  - SSTV images,
  - CD of school photos to be flown on ISS,
  - voice messages and
  - media coverage.
- Rita Wright has developed SuitSat lesson plans for elementary schools, middle schools and High schools.
- Joe Julicher is working with a scout troop building some of the suitsat components.



# Schedule



- Conduct integrated systems test early next year (February 2008).
- Finish development as soon as possible.
- Deliver flight hardware by end of June



# The Suitsat 2 Team



The Goddard Space Flight Center AMSAT team

Orlando AMSAT team

Microchip AMSAT team

Stensat AMSAT team

JSC team

Mark Raptis and his team

Sergey Samburov and his team

Bob McGweir and Frank Brickle (IHU software)